WHAT IS CLAIMED:

1. A method for determining an amount of bandwidth available in at least one communication path coupling a plurality of nodes together, the method comprising the steps of:

exercising the at least one communication path, using information signals, to determine the amount of time it takes for at least one of those information signals to traverse the at least one communication path in at least one direction; and

determining an amount of bandwidth available in at least a portion of the at least one communication path, based on the amount of time determined in the exercising step.

2. A method as set forth in Claim 1, wherein the exercising step includes steps of:

exercising a first, smaller portion of the at least one communication path that includes a first one of the plurality of nodes, using first information signals, to determine an amount of signal propagation delay present in the first node; and

exercising a second, larger portion the at least one communication path that includes the first

node and a second one of the plurality of nodes, using second information signals, to determine an amount of time it takes for at least one of the second information signals to traverse the second, larger portion of the at least one communication path in at least one direction; and

wherein the determining step is performed based on both the amount of time determined in that exercising step and the amount of signal propagation delay determined to be present in the first node.

3. A method as set forth in Claim 2, wherein the first node is located at a Point of Presence, and wherein the bandwidth is in a downlink direction in the at least one communication path, extending from the first node to the second node.

4. A method as set forth in Claim 2, wherein the step of exercising the first, smaller portion of the at least one communication path includes steps of:

forwarding individual ones of the first information signals from a test node, through the first node, and then back again to the test node, by way of the first, smaller portion of the at least one communication path;

determining the amount of time taken for each individual first information signal to arrive back at the test node, after being forwarded from the test node; and

determining a minimum amount of signal propagation delay experienced by the first information signals while passing through the first node, based on the determined amount of time taken for those first information signals to arrive back at the test node; and

wherein the step of determining the amount of bandwidth available in the at least one communication path is performed based, at least in part, on the determined minimum amount of signal propagation delay.

5. A method as set forth in Claim 4, wherein the first node includes a router, and the signal propagation delay is caused by a queuing delay in the router.

6. A method as set forth in Claim 4, wherein the step of determining the minimum amount of signal propagation delay is also performed based on at least one of a size of an individual first information signal and a predetermined bandwidth provided between

the test node and the first node.

7. A method as set forth in Claim 2, wherein the step of exercising the second, larger portion of the at least one communication path using the second information signals includes the steps of:

forwarding at least one second information signal from a test node through the second, larger portion of the communication path to the second node, to cause that second node to transmit at least one third information signal back to the test node through the second, larger portion of the at least one communication path; and

determining a minimum amount of time taken for the at least one third information signal to arrive at the test node, relative to a time when the at least one second information signal was forwarded from the test node; and

wherein the step of determining the amount of bandwidth available in the at least one communication path is performed based, at least in part, on that determined minimum amount of time.

8. A method as set forth in Claim 7, wherein the step of determining the amount of bandwidth available in the at least one communication

path is performed by executing a predetermined algorithm which is defined as follows:

$$BW_{POP-CPE} = (PS)/(RTT_{T-CPE} - ((PS)/BW_{T-POP})-2*MQD)$$

wherein $BW_{POP-CPE}$ represents the amount of bandwidth available in at least a portion of the at least one communication path, RTT_{T-CPE} represents the minimum amount of time taken for the at least one third information signal to arrive at the test node, relative to the time when the at least one second information signal was forwarded from the test node, (PS) represents a predetermined size of an individual one of the second information signals, BW_{T-POP} represents a predetermined bandwidth provided between the test node and the first node, and MQD represents a predetermined minimum queuing delay present in the first node.

9. A method as set forth in Claim 7, wherein the second and third information signals each include information packets, and wherein the information packets of the second information signals are substantially larger in size than the information packets of the first information signals.

10. A method as set forth in Claim 7, wherein the second information signals include

information specifying a predetermined number of hop counts included in the second, larger portion of the at least one communication path, wherein, during the forwarding step, a step is performed of reducing the predetermined number of hop counts specified by the information included in each second signal, based on a number of hops included in the second, larger portion of the at least one communication path, and wherein the second node responds to receiving each individual second signal by further reducing the predetermined number of hop counts specified by the information included in that second information signal, and by then transmitting a corresponding third information signal, based on a result obtained by further reducing that predetermined number of hop counts.

11. A method as set forth in Claim 7, wherein each second information signal includes error-provoking information, and wherein each third signal is an error signal that is transmitted by the second node in response to that second node receiving a corresponding one of the second signals including the error-provoking information.

12. A method as set forth in Claim 11, wherein each third signal is an Internet Control Message Protocol (ICMP) message.

13. A method as set forth in Claim 1, further comprising a step of presenting, to a user, information indicating the determined amount of bandwidth available in the at least one communication path.

14. An apparatus for determining an amount of bandwidth available in at least one communication path coupling a plurality of nodes together, the apparatus comprising:

means for exercising the at least one communication path, using information signals, to determine the amount of time it takes for at least one of those information signals to traverse the at least one communication path in at least one direction; and

means for determining the amount of bandwidth available in at least a portion of the at least one communication path, based on the amount of time determined in the exercising step.

15. An apparatus for determining an amount of bandwidth available in at least one communication path coupling a plurality of nodes together, the apparatus comprising:

a memory storing at least one program;

at least one electronic interface circuit; and

a controller coupled to said memory and to the at least one communication path through said electronic interface circuit, said controller operating under the control of the at least one program stored in said memory for performing (a) an exercising operation for exercising the at least one communication path by causing information signals to traverse that path by way of said electronic interface circuit, (b) a first determining operation for determining, based on the exercising operation, the amount of time taken for at least one of those information signals to traverse the at least one communication path in at least one direction, and (c) a second determining operation of determining the amount of bandwidth available in at least a portion of the at least one communication path, based on the amount of time determined in the first determining operation.

16. An apparatus as set forth in Claim 15, wherein said controller performs the exercising operation by communicating first information signals through a first, smaller portion of the at least one communication path that includes the first node, to

determine an amount of signal propagation delay present in the first node, and by causing second information signals to traverse a second, larger portion of the at least one communication path that includes the first node and a second one of the plurality of nodes, to determine the amount of time it takes for at least one of those second information signals to traverse the second, larger portion of the at least one communication path in at least one direction, and wherein said controller performs the second determining operation based on that determined amount of time and the amount of signal propagation delay determined to be present in the first node.

17. An apparatus as set forth in Claim 16, wherein the first node is located at a Point of Presence, and wherein the bandwidth is in a downlink direction in the at least one communication path, extending from the first node to the second node.

18. An apparatus as set forth in Claim 16, wherein said controller also operates under the control of said at least one program stored in said memory by determining the amount of time taken for each individual first information signal to arrive back at said controller from the first node, after being communicated by said controller to the first

node, and by determining, based on that amount of time determined for each first information signal, the minimum amount of signal propagation delay experienced by the first information signals while passing through the first node, and wherein said controller performs the second determining operation based on that determined minimum amount of signal propagation delay.

19. An apparatus as set forth in Claim 18, wherein the first node includes a router, and the signal propagation delay is caused by a queuing delay in the router.

20. An apparatus as set forth in Claim 18, wherein said memory also stores first information representing a size of an individual first information signal and second information representing a predetermined amount of bandwidth provided in the first, smaller portion of the at least one communication path coupled between said electronic interface circuit and the first node, and wherein said controller determines the minimum amount of signal propagation delay based also on at least one of the first and second information stored in said memory.

21. An apparatus as set forth in Claim 16, wherein said controller performs the second determining operation by executing a predetermined

algorithm defined as follows:

$$BW_{POP-CPE} = (PS)/(RTT_{T-CPE} - ((PS)/BW_{T-POP})-2*MQD)$$

wherein $BW_{POP-CPE}$ represents the amount of bandwidth available in at least a portion of the at least one communication path, RTT_{T-CPE} represents the minimum the amount of time taken for an error message transmitted by a second one of the nodes, to be received by said controller, relative to a time when an error-provoking second information signal was transmitted by said controller, (PS) represents a predetermined size of an individual one of the second information signals, BW_{T-POP} represents a predetermined bandwidth provided in the first, smaller portion of the at least one communication path coupled between said electronic interface circuit and the first node, and MQD represents a predetermined minimum queuing delay present in the first node.

22. An apparatus as set forth in Claim 15, wherein each of the information signals includes an information packet.

23. An apparatus as set forth in Claim 15, further comprising at least one user output interface coupled to said controller, wherein said controller also operates under the control of said at least one

program stored in said memory for controlling the at least one user interface to cause information indicating the determined amount of available bandwidth to be presented to a user, through that at least one output user interface.

24. A program product which includes computer-readable code for executing a method to determine an amount of bandwidth available in at least one communication path coupling a plurality of nodes together, the method comprising the steps of:

exercising the at least one communication path, using information signals, to determine the amount of time it takes for at least one of those information signals to traverse the at least one communication path in at least one direction; and

determining the amount of bandwidth available in at least a portion of the at least one communication path, based on the amount of time determined in the exercising step.

25. A program product as set forth in Claim 24, wherein the exercising step includes steps of:

exercising a first, smaller portion of the at least one communication path that includes a first one of the plurality of nodes, using first information

signals, to determine an amount of signal propagation delay present in the first node; and

exercising a second, larger portion of the at least one communication path that includes the first node and a second one of the plurality of nodes, using second information signals, to determine an amount of time it takes for at least one of the second information signals to traverse the second, larger portion of at least one communication path in at least one direction; and

wherein the determining step is performed based on both the amount of time determined in that exercising step and the amount of signal propagation delay determined to be present in the first node.

26. A program product as set forth in Claim 25, wherein the first node is located at a Point of Presence, and wherein the bandwidth is in a downlink direction in the at least one communication path, extending from the first node to the second node.

27. A program product as set forth in Claim 25, wherein the step of exercising the first, smaller portion of the at least one communication path includes steps of:

forwarding individual ones of the first

information signals from a test node, through the first node, and then back again to the test node, by way of the first, smaller portion of the at least one communication path;

determining the amount of time taken for each individual first information signal to arrive back at the test node, after being forwarded from the test node; and

determining a minimum amount of signal propagation delay experienced by the first information signals while passing through the first node, based on the amount of time taken for those first information signals to arrive back at the test node; and

wherein the step of determining the amount of bandwidth available in the at least one communication path is performed based, at least in part, on the determined minimum amount of signal propagation delay.

28. A program product as set forth in Claim 27, wherein the first node includes a router, and the signal propagation delay is caused by a queuing delay in the router.

29. A program product as set forth in Claim 27, wherein the step of determining the minimum amount

of signal propagation delay is also performed based on at least one of a size of an individual first information signal and a bandwidth provided in the first, smaller portion of the at least one communication path coupled between the test node and the first node.

30. A program product as set forth in Claim 25, wherein the step of exercising the second, larger portion of the at least one communication path using the second information signals includes the steps of:

forwarding at least one second information signal from a test node through the second, larger portion of the at least one communication path to the second node, to cause that second node to transmit at least one third information signal back to the test node through the second, larger portion of the at least one communication path; and

determining a minimum amount of time taken for the at least one third information signal to arrive at the test node, relative to a time when the at least one second information signal was forwarded from the test node; and

wherein the step of determining the amount of bandwidth available in the at least one

communication path is performed based on that determined minimum amount of time.

31. A program product as set forth in Claim 30, wherein the step of determining the amount of bandwidth available in the at least one communication path is performed by executing a predetermined algorithm which is defined as follows:

$$BW_{POP\text{-}CPE} = (PS)/(RTT_{T\text{-}CPE} - ((PS)/BW_{T\text{-}POP})-2*MQD)$$

wherein $BW_{POP\text{-}CPE}$ represents the amount of bandwidth available in at least a portion of the at least one communication path, $RTT_{T\text{-}CPE}$ represents the minimum the amount of time taken for the at least one third information signal to arrive at the test node, relative to a time when the at least one second information signal was forwarded from the test node, (PS) represents a predetermined size of an individual one of the second information signals, $BW_{T\text{-}POP}$ represents a predetermined bandwidth provided between the test node and the first node, and MQD represents a predetermined minimum queuing delay present in the first node.

32. A program product as set forth in Claim 30, wherein the second and third information signals each include information packets, and wherein the

information packets of the second information signals are substantially larger in size than the information packets of the first information signals.

33. A program product as set forth in Claim 30, wherein each second information signal includes error-provoking information, and wherein each third information signal is an error signal that is transmitted by the second node in response to that second node receiving a corresponding second information signal that includes the error-provoking information.

34. A program product as set forth in Claim 33, wherein each third information signal is an Internet Control Message Protocol (ICMP) message.

35. A program product as set forth in Claim 24, wherein the method further comprises a step of presenting, to a user, information indicating the determined amount of bandwidth available in the communication path.

36. A communication system, comprising:

a plurality of nodes;

at least one communication path coupling the plurality of nodes together; and

a test node coupled to a first one of said nodes coupled in said communication path, said test node for exercising the communication path by causing information signals to traverse the path by way of said first node, said test node also for determining, based on the exercising operation, the amount of time it takes for at least one of those information signals to traverse the communication path in at least one direction, and for determining an amount of bandwidth available in at least a portion of the communication path, based on the determined amount of time.

37. A communication system as set forth in Claim 36, further comprising at least one network interposed in said communication path between the first node and a second one of the plurality of nodes.

38. A communication system as set forth in Claim 37, wherein the network operates in accordance with one of Frame Relay (FR) technology and Asynchronous Transfer Mode (ATM) technology.

39. A communication system as set forth in Claim 37, wherein the test node is coupled to the first node through the network, and wherein the first node includes a router located at a Point of Presence.

40. A communication system as set forth in

Claim 37, wherein the second node includes a user communication terminal and the first node includes a router located at a Point of Presence.

41. A communication system as set forth in Claim 40, further comprising a multiplexer/demultiplexer device interposed in said communication path between said network and said second node.

42. A communication system as set forth in Claim 41, wherein said first node is coupled to the Internet through a further communication path, and wherein the second node is coupled to the Internet through the at least one communication path, said first node, and the further communication path.

43. A communication system as set forth in Claim 42, wherein said second node communicates using at least one of Asynchronous Digital Subscriber Line (ADSL) technology, Integrated Services Digital Network (ISDN) technology, and wireless technology.

44. A communication system as set forth in Claim 36, wherein said test node exercises the first node, using information signals, to determine an amount of signal propagation delay present in the first node, and determines the amount of available

bandwidth based on both the determined amount of signal propagation delay and the determined amount of time.

45. A method for determining an amount of bandwidth available in at least one communication path coupling a plurality of nodes together, the method comprising the steps of:

exercising a first portion of the at least one communication path in which a first one of the nodes is coupled, using first information signals, to determine an amount time taken for at least one of those first information signals to traverse the first portion of the at least one communication path, in at least one direction;

determining an amount of signal propagation delay experienced by the at least one first information signal while passing through the first node, based on the determined amount of time;

exercising at least a second, larger portion of the at least one communication path, using second information signals, to determine an amount of time taken for at least one of those second information signals to traverse the second portion of the at least one communication path, in at least one direction,

wherein the first portion of the at least one communication path forms a portion of the second portion of the at least one communication path; and

determining an amount of bandwidth available in at least a portion of the at least one communication path, based on the determined amount of signal propagation delay and the amount of time determined in the step of exercising the second, larger portion of the at least one communication path.

46. A method as set forth in Claim 45, wherein the bandwidth is available in a portion of the at least one communication path which does not include the first portion of the at least one communication path.

47. An apparatus for determining an amount of bandwidth available in at least one communication path coupling a plurality of nodes together, the apparatus comprising:

a memory storing at least one program;

at least one electronic interface circuit; and

a controller coupled to said memory and to the at least one communication path through said

electronic interface circuit, said controller operating under the control of the at least one program stored in said memory for performing (a) a first exercising operation of exercising a first portion of the at least one communication path in which a first one of the nodes is coupled, using first information signals, to determine an amount time taken for at least one of those first information signals to traverse the first portion of the at least one communication path, in at least one direction, (b) a first determining operation to determine an amount of signal propagation delay experienced by the at least one first information signal while passing through the first node, based on the amount of time determined in the first exercising operation, (c) a second exercising operation of exercising a second, larger portion of the at least one communication path, using second information signals, to determine an amount of time taken for at least one of those second information signals to traverse the second portion of the at least one communication path, in at least one direction, and (d) a second determining operation for determining an amount of bandwidth available in at least a portion of the at least one communication path, based on the amount of signal propagation delay determined in the first determining operation and the

amount of time determined in the second exercising operation,

wherein the first portion of the at least one communication path forms a portion of the second portion of the at least one communication path.

48. An apparatus as set forth in Claim 47, wherein the bandwidth is available in a portion of the at least one communication path which does not include the first portion of the at least one communication path.

49. A method for determining at least one bandwidth available in at least one communication path coupling together at least one router and a first node, the method comprising the steps of:

coupling a second, test node to the at least one router;

providing information from the second, test to the first node, through the at least one router and the at least one communication path;

determining an amount of time taken for the information to be received in the first node;

determining an amount of the information

received in the first node; and

determining a first bandwidth available in at least a portion of the at least one communication path, based on the determined amount of time and the determined amount of the information received in the first node.

50. A method as set forth in Claim 49, wherein the information includes an electronic file.

51. A method as set forth in Claim 50, wherein the electronic file has a format in accordance with RFC 959.

52. A method as set forth in Claim 49, wherein the step of determining the amount of time taken for the information to be received in the first node comprises the steps of:

determining a first, earlier time at which a first, beginning portion of the information is received at the first node;

determining a second, later time at which a second, ending portion of the information is received at the first node; and

calculating the amount of time taken for the information to be received in the first node, based on

the determined first and second times.

53. A method as set forth in Claim 52, wherein the step of determining the amount of the information received in the first node includes steps of:

counting a number of bytes included in the information, as the information is being received in the first node, to determine the total number of bytes included in the information; and

multiplying the number of bytes counted in the counting step by a predetermined value to determine the total number of bits included in the information.

54. A method as set forth in Claim 49, further comprising the steps of:

providing the information from the first node to the second, test node through the at least one communication path and the at least one router;

determining an amount of time taken for the information to be received in the second, test node;

determining an amount of the information received in the second, test node; and

determining a second bandwidth available in at least a portion of the at least one communication path, based on that determined amount of time and that determined amount of the information.

55. A method as set forth in Claim 54, wherein the step of determining the amount of time taken for the information to be received in the second, test node comprises the steps of:

determining a third, earlier time at which the first, beginning portion of the information is received at the second, test node;

determining a fourth, later time at which the second, ending portion of the information is received at the second, test node; and

calculating the amount of time taken for the information to be received in the second, test node, based on the determined third and fourth times.

56. A method as set forth in Claim 55, wherein the step of determining the amount of the information received in the second, test node includes steps of:

counting a number of bytes included in the information, as the information is being received in

the second, test node, to determine the total number of bytes included in the information; and

multiplying the number of bytes counted in that counting step by a predetermined value to determine the total number of bits included in the information.

57. A method as set forth in Claim 54, wherein the first bandwidth is available in the at least one communication path in a direction extending from the second, test node to the first node, and wherein the second bandwidth is available in the at least one communication path in a direction extending from the first node to the second, test node.

58. An apparatus for communicating with a node through at least one router and at least one communication path, said apparatus comprising:

a memory storing at least one program;

at least one electronic interface circuit coupled to the at least one router; and

a controller coupled to said memory and to the at least one communication path through said electronic interface circuit and the at least one router, said controller operating under the control of

the at least one program stored in said memory, and being responsive to receiving information from the node through the at least one communication path, the at least one router, and the at least one electronic interface circuit for (a) determining an amount of time taken for the information to be received in the apparatus, (b) determining an amount of the information received in the apparatus, and (c) determining a bandwidth available in at least a portion of the at least one communication path, based on the determined amount of time and the determined amount of the information.

59. An apparatus as set forth in Claim 58, wherein the information is a file having a format in accordance with RFC 959.

60. An apparatus as set forth in Claim 58, wherein the controller is responsive to receiving a first, beginning portion of the information for determining a first, earlier time at which the first, beginning portion of the information is received, said controller also is responsive to receiving a second, ending portion of the information for determining a second, later time at which the second, ending portion of the information is received, and wherein said controller determines the amount of time taken for the

information to be received in the apparatus, based on the determined first and second times.

61. An apparatus as set forth in Claim 60, wherein the controller responds to receiving each individual byte included in the received information, by counting the byte, to determine the total number of bytes included in the information received in the apparatus, and then multiplies the determined total number of bytes by a predetermined value to obtain the total number of bits included in the information.

62. An apparatus as set forth in Claim 58, wherein the controller also operates under the control of the at least one program for forwarding the information received from the node, back to the node, by way of the electronic interface circuit, the at least one router, and the at least one communication path.

63. A program product, for use in a computer coupled to a node through at least one router and at least one communication path, the program product including computer-readable code for executing a method to determine an amount of bandwidth available in the at least one communication path, the method comprising the steps of:

at the computer, detecting the receipt of information forwarded to the computer from the node, through the at least one communication path and the at least one router;

determining an amount of time taken for the information to be received in the computer;

determining an amount of the information received in the computer; and

determining a bandwidth available in at least a portion of the at least one communication path, based on the determined amount of time and the determined amount of the information.

64. A program product as set forth in Claim 63, wherein the information is a file having a format in accordance with RFC 959.

65. A program product as set forth in Claim 63, wherein the detecting step comprises the steps of:

detecting a first, beginning portion of the information; and

detecting a second, ending portion of the information,

wherein the step of determining the amount of time taken for the information to be received in the computer comprises the steps of:

determining a first, earlier time at which the first, beginning portion of the information is detected; and

determining a second, later time at which the second, ending portion of the information is detected, and

wherein the step of calculating the amount of time taken for the information to be received in the computer is performed based on the determined first and second times.

66. A program product as set forth in Claim 65, wherein the step of determining the amount of the information includes steps of:

counting each byte included in the information to determine the total number of bytes included in the information; and

multiplying the determined total number of bytes by a predetermined value to obtain the total number of bits included in the information.

67. A communication system, comprising:

at least one router;

at least one communication path; and

a plurality of nodes coupled together through the at least one communication path and the at least one router,

wherein a first one of said plurality of nodes provides information to a second one of the nodes through the at least one communication path and the at least one router, and

wherein the first node is responsive to receiving the information for (a) determining an amount of time taken for the information to be received in the first node, (b) determining an amount of the information received in the first node, and

(c) determining a first bandwidth available in at least a portion of the at least one communication path, based on the determined amount of time and the determined amount of the information.

68. A communication system as set forth in Claim 67, wherein the first node is responsive to determining the first bandwidth for transmitting the information back to the second node through the at

least one communication path and the at least one router, and wherein the second node is responsive to receiving that information for (a1) determining an amount of time taken for the information to be received in the second node, (b1) determining an amount of the information received in the second node, and (c1) determining a second bandwidth available in at least a portion of the at least one communication path, based on that determined amount of time and that determined amount of the information.

69. A communication system as set forth in Claim 67, wherein the at least one router is located at a Point of Presence of the communication system.